patients with AVS. In group 1, there was lower aortic valve area (0.59 vs 0.77 cm^2) and higher peak systolic retrograde CFV than in group 2, and also higher resting peak diastolic CFV than in groups 2 and 3. In the two AVS groups, retrograde CFV decreased significantly after esmolol (group 1 from −13.8 to −6.5, group 2 from −6.8 to −3.5 cm/sec, $p < 0.01$) while it remained unchanged after atropine. Diastolic CFV was significantly higher in group 1 than in groups 2 and 3 (67.2 vs 30.7 and 19.4 cm/sec, respectively, $p < 0.01$) and significantly decreased after atropine in all subjects. After esmolol, it increased in patients with AVS (group 1 to 85.1, group 2 to 58.4 cm/sec, $p < 0.001$) but did not change in group 3. *Conclusions:* Beta-adrenoreceptor blockers administered acutely to patients with symptomatic or asymptomatic AVS resulted in beneficial coronary flow effects. These changes are closely related to the concomitant beta-blockade induced changes in hemodynamic parameters.

950-158 Can Patients With Severe Aortic Stenosis Undergo Noncardiac Surgery With Acceptable Risk?

L.C. Torsher, C. Shub, S.R. Rettke, D.L. Brown. *Mayo Clinic, Rochester, MN, USA*

Aortic stenosis (AS) is a major risk factor for perioperative cardiac events in patients (pts) undergoing noncardiac surgery (NCS). We previously showed that a small group of selected pts with AS, who were not candidates for, or refused, aortic valve replacement (AVR), were able to undergo NCS with increased, but acceptable, risk. We extended our previous experience over a subsequent five year period by retrospectively analyzing the perioperative course of all cases with severe AS (AV area index <0.5 cm^2/m^2 or gradient > 50 mmHg) by Doppler echocardiography undergoing NCS. 3 pts underwent preop aortic balloon valvuloplasty, but post procedure still had severe AS.

Results: 20 pts, mean age 73 ± 7 years, underwent 29 operative procedures (23 elective and 6 emergency): 13 orthopedic, 5 vascular, 5 intra-abdominal, 4 urologic, 1 ENT, and 1 thoracic. 17 pts (85%) had one or more symptoms: dyspnea (15), angina (5), syncope or presyncope (5). Mean LVEF was 61 ± 13. 27 cases underwent general anesthesia and 2 spinal anesthesia. Intra-arterial monitoring of blood pressure was used in 20 of the 29 cases.

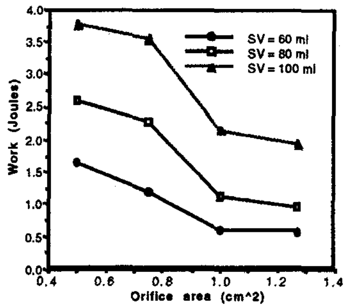
Intraoperative hypotensive events were treated promptly, primarily with phenylephrine. 2 elderly pts had a complicated course and died. The first, a 90-year-old male presenting with hypotension and progressive metabolic acidosis underwent emergency mesenteric artery embolectomy, developed multiorgan failure and support was electively withdrawn 19 days postop. The second, an 89-year-old female underwent elective bilateral total knee arthroplasty, suffered an MI on the second postop day, developed multiorgan failure, and died 17 days postop. There were no other intra or perioperative cardiac events.

Conclusions: Selected patients with severe AS, who are otherwise not candidates for AVR, with appropriate intra and perioperative management, including prompt recognition and treatment of intraoperative hypotension, can undergo NCS with acceptable risk.

950-159 Is There a Fluid Mechanical Explanation for Critical Orifice Areas in Aortic Valve Stenosis? An in Vitro Study

R.S. Heinrich, R.A. Marcus, A.E. Ensley, S.R. Hashim, D.E. Gibson, A.P. Yoganathan. *Iowa Heart Center, Des Moines, IA, USA, Chicago, IL, USA, Georgia Tech, Atlanta, GA, USA*

The reason for the apparent clinical predisposition to hemodynamic decompensation at a specific valve area (<0.75 cm^2) among patients with aortic stenosis is not clear. The purpose of this study was to determine if there was a fluid mechanical explanation for the observed clinical complications that occur at the critical orifice area among patients with aortic valve stenosis. In vitro experiments were performed to enable precise measurement of mechanical work in models of aortic stenosis. Nozzles with orifice areas ranging from 1.27–0.5 cm^2 were examined in a mock circulatory system. Pulsatile flow (flow rate = 2–7 L/min.) was pumped through the nozzles at a heart rate of 60 bpm. Pump work was calculated by measuring flow rate, pressure and on a control volume surrounding the model and applying conservation of energy. For all stroke volumes, there was a striking increase in mechanical work as orifice areas decreased from 1.0 to 0.75 cm^2, as shown in the figure. Mechanical work increased 10.9% as stenotic orifice area decreased from 1.27 to 1.0 cm^2 but increased 87.9% as the area decreased from 1.0 to 0.75 cm^2.

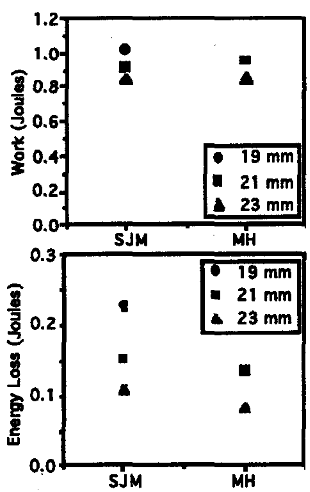


Conclusions: (i) As the valve area approaches the critical value in aortic stenosis, the mechanical workload of the left ventricle is dramatically increased. (ii) These findings could explain the consistent association between critical aortic stenosis and hemodynamic decompensation. (iii) Serial non-invasive analyses of fluid mechanics might enable individualization of the critical value in patients with aortic stenosis.

950-160 Pump Work in Small Size Aortic Valve Mechanical Prostheses: What Are the Hemodynamic Consequences of Choosing a Smaller Valve?

R.S. Heinrich, R.A. Marcus, S.R. Hashim, A.E. Ensley, D.E. Gibson, A.P. Yoganathan. *Iowa Heart Center, Des Moines, IA, USA, Chicago, IL, USA, Georgia Tech, Atlanta, GA, USA*

The hemodynamic consequences of up- or down-sizing prostheses in patients undergoing aortic valve replacement need to be better elucidated. The purpose of this study was to determine the differences in workload and energy loss caused by small changes in prosthetic heart valve size. In vitro experiments were performed to allow precise control and measurement of mechanical work across small-size prosthetic aortic valves. Pulsatile flow (flow rate = 2–7 L/min.) was pumped through 19, 21 and 23 mm St. Jude bileaflet (SJM), and 21 and 23 mm Medtronic-Hall tilting disc (MH) valves. Pump work was calculated by measuring pressure, flow rate and velocity at the boundaries of a control volume surrounding the model and applying conservation of energy. The SJM 19 mm valve required the largest work at all stroke volumes ($p < 0.05$). Differences in work between valves of the same size, but different type, were not significant. As valve diameter decreased from 23 to 21 mm, pump work increased by 9.1% (energy loss by 68.1%) for both SJM and MH valves ($p < 0.05$). In the SJM valve, as diameter decreased from 21 to 19 mm, work increased by 13.7% (energy loss by 72.7%) ($p < 0.05$).



Conclusion: Up- or down-sizing aortic prostheses impacts significantly both on myocardial energy expenditure and on left ventricular mechanical efficiency. The long term consequences of these effects on cardiac structure and function merit further investigation.